DOCUMENT RESUME

ED 107 997 CE 004 266

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TITLE An Analysis of the Residential Electricity Occupation.
INSTITUTION Ohio State Dept. of Education, Columbus. Div. of Vocational Education.; Ohio State Univ., Columbus. Trade and Industrial Education Instructional Materials Lab.
SPONS AGENCY Office of Education (DHEW), Washington, D.C.
PUB DATE [75]
NOTE 82p.; For related documents, see CE 004 160-206, CE 004 263-265, CE 004 267-268, and CE 004 425-427

EDRS PRICE MF-$0.76 HC-$4.43 PLUS POSTAGE
DESCRIPTORS Communication Skills; *Electrical Occupations; *Electricians; *Job Analysis; Knowledge Level; *Occupational Information; Safety; Skill Analysis; Skill Development; Skilled Occupations; *Task Analysis; Task Performance; Work Attitudes
IDENTIFIERS *Residential Electricians

ABSTRACT

The general purpose of the occupational analysis is to provide workable, basic information dealing with the many and varied duties performed in the residential electricity occupation. It does not cover the complete work of a master electrician, only the basic skills needed to do residential wiring. The document opens with a brief introduction followed by a job description. The bulk of the document is presented in table form. Seven duties are broken down into a number of tasks and for each task a two-page table is presented, showing on the first page: tools, equipment, materials, objects acted upon; performance knowledge (related also to decisions, cues and errors); safety--hazard; and on the second page: science; math--number systems; and communications (performance modes, examples, and skills and concepts). The duties include: laying out residential wiring; installing proper entrance service, primary and secondary cable runs, electric heat, miscellaneous wiring, and all finishing electrical devices; and maintaining existing wiring. Appended are lists of mathematics terms and concepts and tools in a standard tool pouch. (BP)

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ED107997

Occupational Analysis

CE004266

MAY 1975

RESIDENTIAL ELECTRICIAN

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EDUCATION & WELFARE
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Instructional Materials Laboratory
Trade and Industrial Education
The Ohio State University

5107

AN ANALYSIS OF THE RESIDENTIAL ELECTRICITY OCCUPATION

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Occupational Analysis
E.P.D.A. Sub Project 73402
June 1, 1973 to December 30, 1974
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Trade and Industrial Education
The Ohio State University

"The activity which is the subject of this report was supported in whole or in part by the U.S. Office of Education, Department of Health, Education, and Welfare. However, the opinions expressed herein do not reflect the position or policy of the U.S. Office of Education, and no official endorsement by the U.S. Office of Education should be inferred."

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FOREWORD

The occupational analysis project was conducted by The Instructional Materials Laboratory, Trade and Industrial Education, The Ohio State University in conjunction with the State Department of Education, Division of Vocational Education pursuant to a grant from the U.S. Office of Education.

The Occupational Analysis project was proposed and conducted to train vocational educators in the techniques of making a comprehensive occupational analysis. Instructors were selected from Agriculture, Business, Distributive, Home Economics and Trade and Industrial Education to gain experience in developing analysis documents for sixty-one different occupations. Representatives from Business, Industry, Medicine, and Education were involved with the vocational instructors in conducting the analysis process.

The project was conducted in three phases. Phase one involved the planning and development of the project strategies. The analysis process was based on sound principles of learning and behavior. Phase two was the identification, selection and orientation of all participants. The training and workshop sessions constituted the third phase. Two-week workshops were held during which teams of vocational instructors conducted an analysis of the occupations in which they had employment experience. The instructors were assisted by both occupational consultants and subject matter specialists.

The project resulted in producing one hundred two trained vocational instructors capable of conducting and assisting in a comprehensive analysis of various occupations. Occupational analysis data were generated for sixty-one occupations. The analysis included a statement of the various tasks performed in each occupation. For each task the following items were identified: tools and equipment; procedural knowledge; safety knowledge; concepts and skills of mathematics, science and communication needed for successful performance in the occupation. The analysis data provided a basis for generating instructional materials, course outlines, student performance objectives, criterion measures as well as identifying specific supporting skills and knowledge in the academic subject areas.

PREFACE

The purpose of the following analysis is to identify the skills and knowledge needed to perform the duties and tasks required of a Residential Electrician. It does not cover the complete work of a Master Electrician, only the basic skills needed to do residential wiring.

ACKNOWLEDGMENT

We wish to acknowledge the valuable assistance rendered by the following subject matter specialists. They provided input to the vocational instructors in identifying related skills and concepts of each respective subject matter area and served as training assistants in the analysis process during the two-week workshops.

Rollin M. Barber, Psychology
The Ohio State University
Columbus, Ohio

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David Porteous, Communications
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Jim VanArsdall, Mathematics
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Lillian Yontz, Biology
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Caldwell, Ohio

Acknowledgment is extended to the following I.M.L. staff members for their role in conducting the workshops; editing, revising, proofing and typing the analyses.

Faith Justice	Research Associate
Sheila Nelson	Administrative Assistant
Marsha Opritza	Editorial Consultant
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JOB DESCRIPTION

A Residential Electrician performs repairs and maintains existing wiring in a residential structure. The electrician is responsible for the layout of new residential wiring, the calculation and installation of branch circuits and basic circuits. The electrician alsc installs proper size entrance service, installs electric heat, installs all electrical devices used in a residence, in a work-like manner to conform to city, county, state and National Electric Code. (NEC)

Duty A Laying out at Residential Wiring

1 Locate and set all switch and receptacle boxes
2 Locate and set all ceiling boxes
3 Locate and set all appliance outlets

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(TASK STATEMENT) LOCATE AND SET ALL SWITCH AND RECEPTACLE BOXES

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Standard tool pouch Switch boxes Fastening devices Blueprint Studdings	Read blueprint Mark proper location of switch box Fasten switch box in place	Safety: Hard hat Gloves Safety glasses Proper shoes Hazard: Flying and falling objects Sharp objects

DECISIONS	CUES	ERRORS
Determine proper materials Determine location	Type of construction National Electric Code Blueprints	Crooked box Wrong location

(TASK STATEMENT) LOCATE AND SET ALL SWITCH AND RECEPTACLE BOXES

SCIENCE	MATH - NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Standard tool pouch] Arrangement of molecules, atoms and ions and the effect of structure and strength of materials [Structure] Resistance of materials to change in shape [Studdings twisting]	Positive rationals Fundamental Operations (Calculation) Basic Measurement Skills and Concepts [Steel tape]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading Viewing	Blueprint Installation	Symbols and terminology Visual analysis Logic Color discrimination Recognition of symbols

(TASK STATEMENT) LOCATE AND SET ALL CEILING BOXES

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Standard tool pouch Ceiling boxes Bar hanger Fastening devices Blueprints Step ladder Ceiling joists	Read blueprint Mark proper location of ceiling box Fasten ceiling box to bar hanger Fasten box and bar hanger in place	Safety: Hard hat Gloves Safety glasses Safety shoes Hazard: Flying and falling objects Sharp objects
DECISIONS	**CUES**	**ERRORS**
Determine proper material and location	Type of construction National Electric Code	Wrong location Twisted bar hanger Box loose

(TASK STATEMENT) LOCATE AND SET ALL CEILING BOXES

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Standard tool pouch] Arrangement of molecules, atoms and ions and the effect on structure and strength of materials [Structure] Resistance of materials to change in shape [Ceiling joists twisting]	Positive rationals Fundamental Operations (Calculation) Basic Measurement Skills and Concepts [Steel tape]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading Viewing	Blueprint Installation	Symbols and terminology Visual analysis Logic Color discrimination Recognition of symbols

(TASK STATEMENT) LOCATE AND SET ALL APPLIANCE OUTLETS

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Standard tool pouch Appliance outlets or disconnects Fastening devices Blueprint Studding	Read blueprint Mark proper location Install with proper fastening devices	Safety: Hard hat Safety glasses Gloves Safety shoes Hazard: Flying and falling objects Sharp objects

DECISIONS	CUES	ERRORS
Determine the proper material	Type of construction National Electric Code	Wrong location Improper connection Box too small for large wire

(TASK STATEMENT) LOCATE AND SET ALL APPLIANCE OUTLETS

SCIENCE	MATH - NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Standard tool pouch] Arrangement of molecules, atoms and ions and the effect on structure and strength of materials [Structure] Basic circuit fundamentals	Positive rationals Fundamental Operations (Calculation) Basic Measurement Skills and Concepts [Steel tape]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading Viewing	Blueprint Installing	Symbols and terminology Visual analysis Logic Color discrimination Recognition of symbols

Duty B Installing Proper Entrance Service

1 Calculating total load
2 Locate and set meter enclosure
3 Locate and set main distribution panel
4 Run entrance cable
5 Install grounding system

(TASK STATEMENT) CALCULATING TOTAL LOAD IN CIRCUIT

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Pencil Paper National Electric Code	Take load from blueprint or data plate Apply power or Ohm's Law formula to change to amps Apply amp load to National Electric Code for wire size	

DECISIONS	CUES	ERRORS
What size wire or fuse to use	Blueprint Data plate on appliance National Electric Code	Fire hazard Waste the material Wire will not carry load

(TASK STATEMENT) CALCULATING TOTAL LOAD IN CIRCUIT

SCIENCE	MATH – NUMBER SYSTEMS
Ohm's Law Power Law Understanding current flow	Positive rationals Fundamental Operations (Calculation) Addition, Subtraction, Multiplication, Division Basic Arithmetic Skills and Concepts [Decimal calculations] Measurements [Amps, watts] Read and interpret tabels, charts and graphs [National Electric Code tables] Basic Algebra Skills and Concepts [Ohm's Law, Power Law]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading	Data plate or blueprint	Detail Terminology
Writing	Data plate or blueprint	Process report
Viewing	Data plate or blueprint	Color discrimination Recognition of symbols and codes

(TASK STATEMENT) LOCATE AND SET METER ENCLOSURE

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Standard tool pouch Meter enclosure Fastening devices Blueprint Proper ladder Wall	Read blueprint Make proper location Install with proper fastening devices	Safety: Hard hat Safety glasses Gloves Safety shoes Hazard: Flying and falling objects Sharp objects

DECISIONS	CUES	ERRORS
Determine the proper material	Type of construction Type of enclosure National Electric Code	Wrong meter enclosure Wrong location Loose meter enclosure

(TASK STATEMENT) LOCATE AND SET METER ENCLOSURE

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Standard tool pouch] Arrangement of molecules, atoms and ions and the effect on structure and strength of materials [Structure]	Positive rationals Fundamental Operations (Calculation) Basic Measurement Skills and Concepts [Steel tape]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading	Blueprint	Symbols Terminology
Viewing	Installation	Visual analysis Logic Color discrimination Recognition of symbols

(TASK STATEMENT) LOCATE AND SET MAIN DISTRIBUTION PANEL

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Standard tool pouch Distribution panel Proper fastening devices Blueprint Ladder Wall	Read blueprint Make proper location Install with proper fastening devices	Safety: Hard hat Safety glasses Gloves Shoes Hazard: Flying and falling objects Sharp objects Falling panel

DECISIONS	CUES	ERRORS
Determine size and type of panel Determine size of fuses Determine proper fastening devices	Total load Weatherproof or non-weatherproof Type of construction Surface or enclosed type National Electric Code	Water in fuse box Overload Fire

(TASK STATEMENT) LOCATE AND SET MAIN DISTRIBUTION PANEL

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Standard tool pouch] Arrangement of molecules, atoms and ions and the effect on structure and strength of materials [Structure] Resistance of materials to change in shape [Twisting] Basic circuit knowledge	Positive rationals Fundamental Operations (Calculation) Basic Measurement Skills and Concepts [Steel tape]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading Viewing	Blueprints Installation	Symbols and terminology Visual analysis Logic Recognition of symbols

(TASK STATEMENT) RUN ENTRANCE CABLE

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Proper entrance cable Straps Standard tool pouch Ladder Service head Weatherproof connectors Non-weatherproof connectors Wall	Select and strip cable Put on service head Install connectors Insert wire in connectors Strip cable Insert in meter enclosure and main panel	Safety: Safety glasses Hard hat Gloves Safety shoes Hazard: Flying and falling objects Cut hands

DECISIONS	CUES	ERRORS
Determine size cable Determine type connectors	Need total load Inside or outside use National Electric Code	Overheated cable Corrosion in meter enclosure

(TASK STATEMENT) RUN ENTRANCE CABLE

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Standard tool pouch] Effect of heating and cooling on expansion of materials [Cable] Transfer of heat from one body to another [Tight cable] Arrangement of molecules, atoms and ions and the effect on structure and strength of materials [Strength of cable] Resistance of materials to change in shape [Bending cable] Resistance of materials to flow of electrical current [Resistance of cable] Basic circuit knowledge	Positive rationals Fundamental Operations (Calculation) Basic Measurement Skills and Concepts [Steel tape]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading Viewing	Blueprint Installation	Symbols and terminology Visual analysis Logic Color discrimination Recognition of symbols

(TASK STATEMENT) INSTALL GROUNDING SYSTEM

TOOLS, EQUIPMENT, MATERIALS OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Standard tool pouch Ground rod Ground rod clamp Sledge hammer Proper ground wire Required cable fasteners Step ladder Earth	Drive ground rod Secure ground rod clamp on rod Connect ground wire to meter enclosure Connect ground wire to ground clamp Secure ground wire to building	Safety: Hard hat Safety glasses Gloves Safety shoes Hazard: Flying and falling objects Sharp objects

DECISIONS	CUES	ERRORS
Size of ground wire Size of ground rod Type of fasteners	Type of construction Total load National Electric Code	Floating ground Unbalanced load

(TASK STATEMENT) INSTALL GROUNDING SYSTEM

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Standard tool pouch] Resistance of materials to flow of electrical current [Resistance of flow of electrical current] Basic circuit fundamentals Basic knowledge of protection of grounding in circuits	Positive rationals Fundamental Operations (Calculation) Basic Measurement Skills and Concepts [Steel tape]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Viewing	Installation	Visual analysis Logic Color discrimination

Duty C Installing Primary and Secondary Cable Runs

1 Prepare cable for inserting box
2 Run secondary cable between outlet boxes
3 Secure cable in outlet boxes
4 Securing ground to all devices
5 Splice all cables
6 Run primary cable for feed from main panel

(TASK STATEMENT) PREPARE CABLES FOR INSERTING IN BOXES

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY - HAZARD
Standard tool pouch One type of each cable	Measure back eight inches on cable Use cable stripper to remove sheath Use knife to strip sheath	Safety: Hard hat Safety glasses Gloves Proper use of knife Safety shoes Hazard: Flying and falling objects Sharp objects

DECISIONS	CUES	ERRORS
Use knife or stripper	Size of cable National Electric Code	Cut insulation

(TASK STATEMENT) ...ARE CABLES FOR INSERTING ... BC...

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Standard tool pouch] Resistance of materials to change in shape [Resistance of cable to bending]	Positive rationals Fundamental Operations (Calculation) Basic Measurement Skills and Concepts [Steel tape]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Viewing	Installation	Visual Color discrimination

(TASK STATEMENT) RUN SECONDARY CABLE BETWEEN OUTLET BOXES

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Standard tool pouch Electric drill Wood bit Blueprint Studdings Proper cable	Drill holes between boxes Select proper size cable Prepare wire by stripping Insert in boxes	Safety: Hard hat Safety glasses Gloves Safety shoes Hazard: Falling objects Splinters
DECISIONS Select: Where to drill holes What size hole to drill Proper size cable	**CUES** Size of cable Understand construction as the where to drill holes Knowledge of circuit National Electric Code	**ERRORS** Nail through wire Use too much wire

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(TASK STATEMENT) RUN SECONDARY CABLE BETWEEN OUTLET BOXES

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Standard tool pouch] Effects of friction on work processes and product quality [Pulling cable through holes] Resistance of materials to change in shape [Cable runs] Basic circuit fundamentals	Positive rationals Fundamental Operations (Calculation) Basic Measurement Skills and Concepts [Steel tape]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Viewing	Installation	Visual analysis Logic Color discrimination Recognition of symbols
Reading	Blueprint	Symbols and terminology

(TASK STATEMENT) SECURE CABLE IN OUTLET BOXES

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Standard tool pouch Boxes/clamps Connectors	Remove proper knock out Insert connector if needed Tighten clamp on cable	Safety: Hard hat Safety glasses Gloves Safety shoes Hazard: Flying and falling objects Sharp objects

DECISIONS	CUES	ERRORS
What type connector What type clamp	Size of wire Location (outside or inside) National Electric Code	Shorted cable Water in outlet

(TASK STATEMENT) SECURE CABLE IN OUTLET BOXES

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Standard tool pouch] Resistance of materials to change in shape [Bending cable to insert in outlet box]	Positive rationals Fundamental Operations (Calculation) Basic Measurement Skills and Concepts [Steel tape]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Viewing	Installation	Visual analysis Logic

(TASK STATEMENT) SECURING GROUND TO ALL DEVICES

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Standard tool pouch Crimping tool Crimping sleeves Devices needing grounded	Insert all bare ground in grounding sleeve Insert six inches pig tail in sleeve Crimp Insert pig tail under green ground lug of device	Safety: Hard hat Safety glasses Gloves Safety shoes First aid card Hazard: Flying and falling objects Sharp objects Treatment of electrical shock
DECISIONS	**CUES**	**ERRORS**
Select: Size and type of grounding sleeve Type of crimping tool	Size of wire Type of wire Device to be grounded National Electric Code	Can produce hazardous shock Fire

(TASK STATEMENT) SECURING GROUND TO ALL DEVICES

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Standard tool pouch] Resistance of materials to change in shape [Bending ground wire] The importance of case ground and why it is used	Positive rationals Fundamental Operations (Calculation) Basic Measurement Skills and Concepts [Steel tape]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Viewing	Installation	Visual analysis Logic Color discrimination Recognition of symbols

(TASK STATEMENT) SPLICE ALL CABLES

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Standard tool pouch Wire nuts Propane tank Solder gun Solder 50/50 Step ladder Aluminum connectors Flux Tape Aluminum neutralizer Cables needing splicing	Remove insulation from cable Twist good mechanic's splice Clean joint, apply flux Heat to proper temperature Apply solder 50/50 Apply wire nut or tape Use aluminum connectors for aluminum wire Apply neutralizer when using aluminum with copper	Safety: Hard hat Safety glasses Gloves Safety shoes Hazard: Flying and falling objects Sharp objects Hot solder

DECISIONS	CUES	ERRORS
What size and type of connector to use Type of mechanical joint Type of insulation Proper circuit splices	Cable Location of splice Knowledge of circuits National Electric Code Splice must always be made in box	Short in wire Fire

(TASK STATEMENT) SPICE ALL CABLES

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Standard tool pouch] Transfer of heat from one body to another [Soldering splices] Basic knowledge of circuits	Positive rationals Fundamental Operations (Calculation) Basic Measurement Skills and Concepts [Steel tapes]

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COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading	Blueprint	Symbols and terminology
Viewing	Installation	Visual analysis Logic Color discrimination Recognition of symbols

(TASK STATEMENT) RUN PRIMARY CABLE FOR FEED FROM MAIN PANEL

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TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Standard tool pouch Drill Wood bit Blueprint Studdings	Drill holes from panel to outlet box Prepare wire by stripping Insert in box	Safety: Hard hat Safety glasses Gloves Safety shoes Hazard: Flying and falling objects Sharp splinters

DECISIONS	CUES	ERRORS
Where to drill holes What size hole to drill	Size of cable Understand construction as to where to drill holes National Electric Code	Nail through wire Use too much wire

(TASK STATEMENTS FOR PRIMARY CABLE FOR PLED [illegible] MAN PANEL

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Standard tool pouch] Effects of friction on work processes and product quality [Pulling cable through hole] Basic circuit knowledge	Positive rationals Fundamental Operations (Calculation) Basic Measurement Skills and Concepts [Steel tapes]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading Viewing	Blueprint Installation	Symbols and terminology Visual analysis Logic Color discrimination Recognition of symbols

Duty D Installing Electric Heat

1 Install line and low voltage thermostat
2 Install baseboard heaters
3 Install ceiling heat
4 Install central electric heat (wiring only)

(TASK STATEMENT) INSTALL LINE AND LOW VOLTAGE THERMOSTATS

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Standard tool pouch Low voltage thermostat In line thermostat Volt Ohm's Meter	Check control line voltage 24 volts or under–install low voltage thermostat 110 volts–install in line thermostat 220 volts–install in line thermostat to break both sides of line	Safety: Hard hat Safety glasses Gloves Safety shoes Hazard: Flying and falling objects Sharp splinters
DECISIONS	**CUES**	**ERRORS**
What thermostat to use	Voltage Load National Electric Code	Electrical hazard of shock

(TASK STATEMENT) INSTALL LINE AND LOW VOLTAGE THERMOSTATS

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Standard tool pouch] Basic knowledge of circuits Function of thermostats	Positive rationals Fundamental Operations (Calculation) Basic Measurement Skills and Concepts [Steel tape, Volt Ohm's Meter]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading Viewing	Blueprint Installation	Symbols and terminology Visual analysis Logic Color discrimination Recognition of symbols

(TASK STATEMENT) INSTALL BASEBOARD HEATERS

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Standard tool pouch Fastening devices Heaters Connectors Blueprint Wall Meggar	Mount heating units to blueprint specifications Install proper connectors Insert wire Make proper connections Ground test	Safety: Hard hat Safety glasses Gloves Safety shoes Hazard: Flying and falling objects Sharp splinters

DECISIONS	CUES	ERRORS
Size of heaters How to fasten Location	Blueprint Type of construction Insulation Size of area National Electric Code	Room too cold

(TASK STATEMENT) INSTALL BASEBOARD HEATERS

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Standard tool pouch] Baisc knowledge of circuits	Positive rationals Fundamental Operations (Calculation) Basic Measurement Skills and Concepts [Steel tape, Meggar]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading Viewing	Blueprint Installation	Symbols and terminology Visual analysis Logic Recognition of symbols

(TASK STATEMENT) INSTALL CEILING HEAT

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Standard tool pouch Ladder Blueprint Staple gun and staples Ceiling (rock lath) Volt Ohm's Meter	Layout room Insert both ends of cable in outlet box Staple cable to ceiling Read for continuity check	Safety: Hard hat Safety glasses Gloves Safety shoes Hazard: Flying and falling objects Sharp splinters

DECISIONS	CUES	ERRORS
Size of heating unit	Size of room National Electric Code	Room too cold

LH

(TASK STATEMENT) INSTALL CEILING HEAT

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Standard tool pouch] Transfer of heat from one body to another [Type of material to mount heating unit on] Resistance of materials to flow of electrical current [Resistance of material to flow of electricity] Resistance of materials to change in shape [Bending of cable] Basic knowledge of circuits	Positive rationals Fundamental Operations (Calculation) Basic Measurement Skills and Concepts [Steel tape, Volt Ohm's Meter]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading Viewing	Blueprint Installation	Symbols and terminology Visual analysis Logic Color discrimination Recognition of symbols

(TASK STATEMENT) INSTALL CENTRAL ELECTRIC HEAT (WIRING ONLY)

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Standard tool pouch Central heating unit Ladder Connectors	Connect cable to heater Set thermostat Check for ground	Safety: Hard hat Safety glasses Gloves Safety shoes Hazard: Flying and falling objects Sharp splinters

DECISIONS	CUES	ERRORS
Cable size Fuse size	Size of heating unit National Electric Code	Insufficient heat Fire

(TASK STATEMENT) INSTALL CENTRAL ELECTRIC HEAT (WIRING ONLY)

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Standard tool pouch] Resistance of materials to change in shape [Bending of cable] Basic knowledge of circuits	Positive rationals Fundamental Operations (Calculation) Basic Measurement Skills and Concepts [Steel tape]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading Viewing	Blueprint Installation	Symbols and terminology Visual analysis Logic Recognition of symbols

Duty E Installing Miscellaneous Wiring

1 Install intercom
2 Install low voltage lighting control
3 Install outlet for garage door

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(TASK STATEMENT) INSTALL INTERCOM

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Standard tool pouch Proper wire and multiple conductor cable Fastening device Ladder Drill Bits	Install master control unit Install all slave units Run wire or cable between units Connect low voltage wire to units Connect 110 volt feed to master unit	Safety: Hard hat Safety glasses Gloves Safety shoes Hazard: Flying and falling objects Sharp splinters
DECISIONS	**CUES**	**ERRORS**
How many master units How many slave units What type cable or wire How to secure unit	Blueprints Instructions from supervisor Total load National Electric Code	Injury to units Not enough units

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(TASK STATEMENT) INSTALL INTERCOM

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Standard tool pouch] Basic knowledge of circuits	Positive rationals Fundamental Operations (Calculation) Basic Measurement Skills and Concepts [Steel tape]

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COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading	Blueprints Process report (instructions)	Symbols and terminology
Viewing	Installation	Visual analysis Logic Color discrimination Recognition of symbols

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(TASK STATEMENT) INSTALL LOW VOLTAGE LIGHTING CONTROL

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Standard tool pouch Relays (select proper ones) Power supply Push buttons Fastening device Wire Volt Ohm's Meter	Locate units Run low voltage wire Install power supply Install relays at lights Install push buttons Check with Volt Ohm's Meter	Safety: Hard hat Safety glasses Gloves Safety shoes Hazard: Flying and falling objects Sharp splinters

DECISIONS	CUES	ERRORS
Three wire or four wire relay Size of power supply Three wire or four wire Type push button	Blueprint Pilot light Number of locations National Electric Code	Burnt out relays Overloaded power supply

(TASK STATEMENT) INSTALL LOW VOLTAGE LIGHTING CONTROL

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Standard tool pouch] Resistance of materials to change in shape [Bending of cable] Basic knowledge of circuits	Positive rationals Fundamental Operations (Calculation)

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading Viewing	Blueprint Process report (instruction) Installation	Symbols and terminology Visual analysis Logic Color discrimination Recognition of symbols

(TASK STATEMENT) INSTALL OUTLET FOR GARAGE DOOR

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Standard tool pouch Ladder Outlet box Cable	Locate exact position of garage door Run proper cable Install proper disconnect Mount proper outlet box Insert cable Install proper outlet	Safety: Hard hat Safety glasses Gloves Safety shoes Hazard: Flying and falling objects Sharp splinters

DECISIONS	CUES	ERRORS
Where to put outlet box What size wire What size fuse	Blueprint Size of unit in amps National Electric Code	Inoperable door Wrong location

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(TASK STATEMENT) INSTALL OUTLET FOR GARAGE DOOR

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Standard tool pouch] Basic knowledge of circuits	Positive rationals Fundamental Operations (Calculation) Basic Measurement Skills and Concepts [Steel tape]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading Viewing	Blueprint Installation	Symbols and terminology Visual analysis Logic Color discrimination Recognition of symbols

Duty F Installing all Finishing Electrical Devices

1 Install split circuit duplex receptacles
2 Install proper switches and receptacles
3 Install lighting fixtures
4 Take meggar reading on system
5 Hook up all appliances

5-8

(TASK STATEMENT) INSTALL SPLIT CIRCUIT DUPLEX RECEPTACLES

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Standard tool pouch Split circuit receptacles	Break out connecting link on brass side of duplex outlet Place white wire on white screw Place red wire on No. 1 brass screw Place black wire on No. 2 brass screw Place bare wire on green lug Insert in switch box Install plate	Safety: Hard hat Safety glasses Gloves Safety shoes Hazard: Flying and falling objects Sharp splinters

DECISIONS	CUES	ERRORS
Size of wire Fuses	Blueprint What is receptacle used for National Electric Code	Blown fuse 220 volts instead of 110 volts

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(TASK STATEMENT) INSTALL SPLIT CIRCUIT DUPLEX RECEPTACLES

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Standard tool pouch] Resistance of materials to flow of electrical current [Capacity of receptacles] Basic knowledge of circuits	Positive rationals Fundamental Operations (Calculation)

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COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading Viewing	Blueprint Installation	Symbols and terminology Visual analysis Logic Color discrimination Recognition of symbols

(TASK STATEMENT) INSTALL PROPER SWITCHES AND RECEPTACLES

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TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Standard tool pouch Proper switch [Single pole switch, three-way switch, four-way switch] Proper receptacles	Connect proper switch or receptacle Install in switch box Install plate	Safety: Hard hat Safety glasses Gloves Safety shoes Hazard: Flying and falling objects Sharp splinters

DECISIONS	CUES	ERRORS
What switch to use What receptacle to use	Blueprint National Electric Code	Will not operate properly

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(TASK STATEMENT) INSTALL PROPER SWITCHES AND RECEPTACLES

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Standard tool pouch] Basic knowledge of circuits	Positive rationals Fundamental Operations (Calculation)

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading Viewing	Blueprint Installation	Symbols and terminology Visual analysis Logic Color discrimination Recognition of symbols

(TASK STATEMENT) INSTALL LIGHT FIXTURES

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Standard tool pouch Proper light fixture Proper fastening devices Step ladder Wire nuts	Remove insulation from wire Secure white wire from outlet to white wire from fixture Secure black wire from outlet to black wire from fixture Secure with wire nuts Mount with proper devices	Safety: Hard hat Safety glasses Gloves Safety shoes Hazard: Flying and falling objects Sharp splinters
DECISIONS	**CUES**	**ERRORS**
How to fasten What fixture to use	Blueprint Construction National Electric Code	Fixture falling Short in fixture

(TASK STATEMENT) INSTALL LIGHT FIXTURES

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Standard tool pouch] Basic knowledge of circuits	Positive rationals Fundamental Operations (Calculation)

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading Viewing	Process report (instructions) Installation	Terminology and symbols Visual analysis Logic Color discrimination

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(TASK STATEMENT) TAKE MEGGAR READING ON SYSTEM

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Standard tool pouch Meggar Ladder Blueprint	Turn on all switches Remove both sides of line from panel Connect meggar by placing one clip on one side of line and one clip on the other Turn meggar handle and read If it does not read proper reading; check Then read to ground	Safety: Hard hat Safety glasses Gloves Safety shoes Hazard: Flying and falling objects Sharp splinters
DECISIONS	**CUES**	**ERRORS**
Determine circuit discrepancy	What is reading National Electric Code	Short in line

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(TASK STATEMENT) TAKE MEGGAR READING ON SYSTEM

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Standard tool pouch] Basic knowledge of circuits	Positive rationals Fundamental Operations (Calculation) Basic Measurement Skills and Concepts [Meggar]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading	Meter	Comprehension Description of mechanism
Viewing	Color of cable	Color discrimination

(TASK STATEMENT) HOOK-UP ALL APPLIANCES

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Standard tool pouch Connectors Wire nuts Torch Solder Tape	Install proper connector Strip and install previous run wire Connect proper wire Use wire nuts or solder Insulate splice	Safety: Hard hat Safety glasses Gloves Safety shoes Hazard: Flying and falling objects Sharp splinters

DECISIONS	CUES	ERRORS
What size wire nuts What insulation	Blueprint Size of wire National Electric Code	Loose connections Overheated wire

(TASK STATEMENT) HOOK-UP ALL APPLIANCES

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Standard tool pouch] Fluids under pressure [Propane torch] Transfer of energy from one form to another [Propane torch] Basic knowledge of circuits	Positive rationals Fundamental Operations (Calculation)

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading Viewing	Blueprints Wire color code Installation	Terminology Color discrimination Visual analysis Logic Recognition of symbols

Duty G Maintaining Existing Wiring

1 Install receptacles and switch in old wall
2 Locate ground (short) in system
3 Locate open in system
4 Replace existing receptacles and switches
5 Increase entrance service size

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(TASK STATEMENT) INSTALL RECEPTACLE AND SWITCH IN OLD WALL

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY - HAZARD
Standard tool pouch Keyhole saw Old work switch box Pair of Madison holders Drill Bit Connector Staples Wire Duplex receptacle and single pole switch Proper plates	Cut hole for switch box Drill plate below switch box Insert wire from basement through hole to box Strip cable and insert in box Install switch or receptacle Install plate Run wire to supply location Insert connector Strip wire and insert in supply outlet Splice wire	Safety: Hard hat Safety glasses Gloves Safety shoes Hazard: Flying and falling objects Sharp splinters

DECISIONS	CUES	ERRORS
Where to cut hole What cable to use What device to use	Information from supervisor Type of construction National Electric Code	Drill hole in floor by mistake Wrong location

TASK STATEMENT: INSTALL RECEPTACLES AND SWITCH IN OLD WALL

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Standard tool pouch] Basic knowledge of circuits	Positive rationals Fundamental Operations (Calculation) Basic Measurement Skills and Concepts [Steel tape]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Viewing	Installation	Visual analysis Logic Color discrimination Recognition of symbols
Reading	Ruler or tape	Comprehension Detail

(TASK STATEMENT) LOCATE GROUND (SHORT) IN SYSTEM

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Standard tool pouch Volt Ohm's Meter	Connect one side of Volt Ohm's Meter to hot side of line Connect other to white side of line on suitable ground Start on far end of circuit disconnecting Proceed disconnecting towards meter till reading drops Repair or replace grounded section	Safety: Hard hat Safety glasses Gloves Safety shoes Hazard: Flying and falling objects Sharp splinters

DECISIONS	CUES	ERRORS
Where to find the circuit Where to connect meter	What fuse is blown National Electric Code	Dead circuit

(TASK STATEMENT) LOCATE GROUND (SHORT) IN SYSTEM

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Standard tool pouch] Basic knowledge of circuits	Positive rationals Fundamental Operations (Calculation) Basic Measurement Skills and Concepts [Volt Ohm's Meter]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading	Volt Ohm's Meter	Comprehension Description of mechanism
Viewing	Volt Ohm's Meter	Visual analysis Detail/Inference Color discrimination
Touching	Cable	Dampness

(TASK STATEMENT) LOCATE OPEN IN SYSTEM

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Standard tool pouch Volt Ohm's Meter	Disconnect circuit from system Connect Volt Ohm's Meter at circuit after disconnect Proceed away from meter shorting lines When point is reached and no reading is obtained replace that section of cable	Safety: Hard hat Safety glasses Gloves Safety shoes Hazard: Flying and falling objects Sharp splinters

DECISIONS	CUES	ERRORS
Where to find the circuit	What part of circuit is not working National Electric Code	Dead circuit

(TASK STATEMENT) LOCATE OPEN IN SYSTEM

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Standard tool pouch] Basic knowledge of circuits	Positive rationals Fundamental Operations (Calculation) Basic Measurement Skills and Concepts [Volt Ohm's Meter]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading	Volt Ohm's Meter	Comprehension Terminology Description of mechanism
Viewing	Color of cable	Color discrimination

(TASK STATEMENT) REPLACE EXISTING RECEPTACLES AND SWITCHES

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Standard tool pouch Duplex receptacles Proper switch Ground fault tester	Locate bad component Secure replacement device Interchange Run ground fault check	Safety: Hard hat Safety glasses Gloves Ground fault tester Safety shoes Hazard: Flying and falling objects Sharp splinters Eliminate shock hazard
DECISIONS	**CUES**	**ERRORS**
What to replace	What is not working National Electric Code	Faulty system

(TASK STATEMENT) REPLACE EXISTING RECEPTACLES AND SWITCHES

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Standard tool pouch] Basic knowledge of circuits	Positive rationals Fundamental Operations (Calculation) Basic Measurement Skills and Concepts [Steel tape]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading	Information from devices	Comprehension Detail Description of mechanism
Viewing	Equipment to replace	Logic Visual analysis Color discrimination

(TASK STATEMENT) INCREASE ENTRANCE SERVICE SIZE

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Standard tool pouch Service head Cable Meter enclosure Connectors Ground rod Ground clamp Ground wire Sledge	Have power company locate new meter location and to disconnect old service Remove old service Replace with new components Have power company to inspect and hook-up	Safety: Hard hat Safety glasses Gloves Safety shoes Hazard: Flying and falling objects Sharp splinters

DECISIONS	CUES	ERRORS
What size service to replace with	Total load National Electric Code	Over-heated service

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(TASK STATEMENT) INCREASE ENTRANCE SERVICE SIZE

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Standard tool pouch] Basic knowledge of circuits	Positive rationals Fundamental Operations (Calculation)

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading	Calculations	Comprehension Detail Informational reports Recommendation reports Description of mechanism
Viewing	Installation	Visual analysis Logic Color discrimination
Touching	Existing cable	Warm or hot

APPENDIX
MATHEMATICS

Fundamental Operations (calculation)
- Addition algorithm
- Subtraction algorithm
- Multiplication algorithm
- Division algorithm
- Order of operations, i.e., use of parentheses in simplifying arithmetic expressions

Basic Arithmetic Skills and Concepts
- Reduction of fractions
- Changing mixed numbers to improper fractions
- Changing percents to fractions and fractions to percents
- Finding a percent of a number and what percent one number is of another
- Changing fractions to decimals and decimals to fractions
- Ratio and proportion
- Estimation
- Rounding off decimals and whole numbers
- Approximation using scientific notation
- Guess and check method
- Rules of thumb
- Property of comparison
  - Equality/equivalence
  - Inequality/greater than/less than

Basic Measurement Skills and Concepts
- ''Measure sense''/role of ''unit''
- Use of appropriate measuring instruments
- Given an Instrument of Measure, determine precision and/or accuracy with respect to relative error, significant digits and tolerance
- Metric and English measure and conversion
- Rate
- Measurement: geometric
  - Linear, area, volume, angle
- Measurement: non-geometric
  - Time, money, temperature, weight, liquid, dry speed, pressure
- Conversion from one standard unit to another
- Read and interpret tables, charts and graphs

Basic Algebra Skills and Concepts

- Use of variables:
  - in formulae
  - in equations
  - in functions
  - for stating axioms and properties
  - as parameters
- Expression of product in terms of its prime factors, numerical or monomial
- Manipulation of formulae
- Write as a formula or equation a relationship given in words
- Substitute given values in order to find the value of the required unknown
- Solve problems involving numerical algebraic expressions
- Solve problems involving literal algebraic expressions
- Use of exponents to indicate the power of a number
- Algebraic subtraction, multiplication and division of numerical and literal terms
- Algebraic multiplication of two monomials and polynomials with exponents
- Algebraic division of polynomials and monomials
- Solve simple algebraic and quadratic equations
- Solve a set of simultaneous equations in two or more unknowns using substitutions and elimination, i.e., addition and subtraction techniques
- Understanding and use of matrices

Tools in Standard Tool Pouch or Equivalent

Pouch
Knife
Belt
Ruler
Magnet level
Long nose plier
Diagonal plier
8'' crescent wrench
Screwdrivers of various sizes
10'' channellock
9'' plier
Fuse puller
Two testers
Stripper
Flashlight with batteries